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Assessing Dengue Hemorrhagic Fever Risk: Insights from Behavioral Aspects and Home Environmental Conditions

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ABSTRACT

As the provincial capital, Jambi City has witnessed rapid development, evident in the construction of 5,000 housing units between 2019 and 2021 amid the COVID-19 pandemic. However, if left unoccupied, these settlements could potentially become breeding grounds for mosquito larvae, particularly Aedes aegypti, contributing to the escalating dengue cases in the city. This study aims to analyze the risk factors for dengue hemorrhagic fever based on behavioral aspects and environmental conditions. Conducted in the Pinang Merah Alam Barajo Urban Village of Jambi City, this observational analytic study involved 108 randomly selected respondents. The research data underwent analysis using the chi-square test, with statistical significance set at ≤ 0.05. The findings revealed that most community behaviors fell into the 'good' category, including habits like hanging clothes, collecting rainwater around the house, using abate powder in water reservoirs, weekly drainage of water reservoirs, proper disposal of used items, monitoring of larvae through cards, and keeping larvae-eating fish. The incidence of dengue hemorrhagic fever was significantly associated with hanging clothes indoors (p=0.000), collecting rainwater around the house (p=0.004), and draining water reservoirs once a week (p=0.004). However, no significant associations were found with the use of abate powder (p=0.380), disposing of used goods (p=0.087), monitoring larvae with cards (p=0.134), and keeping fish (p=0.122). In conclusion, the study highlights a strong correlation between dengue hemorrhagic fever and certain behaviors, notably hanging clothes indoors, collecting rainwater around the house, and draining water reservoirs on a weekly basis.

Keywords: Dengue, Aedes Aegypti, Behavior, Vector

INTRODUCTION

Dengue Hemorrhagic Fever (DHF) remains a significant health concern in Indonesia, with the number of cases increasing annually (Alifariki, L O, 2017), (Arimaswati et al., 2020). As outlined in the NTDs Roadmap 2021-2030, dengue is one of the targeted diseases for prevention and control efforts. The objective set for dengue control aims to decrease the mortality rate (Case Fatality Rate or CFR) from 0.80% (in 2020) to 0% by 2030. However, by 2022, the CFR for DHF had reached 0.90%, marking a 34.33% increase (Tansil et al., 2021). In Jambi province in 2022, there were 1,381 reported DHF cases resulting in 9 deaths. These figures show a significant rise compared to 2021, which accounted for 357 cases and 5 deaths. The Incidence Rate (IR) of Dengue Hemorrhagic Fever (DHF) per 100,000 people in Jambi city was 48.1 (Department of Health Jambi Province, 2020).

Jambi City is situated astronomically at 01°30'2.98" - 01°7'1,07" LS and 103°40'1.67" - 103°40'0.23" East, with an average elevation of 10-60 meters above sea level. The city has witnessed the construction of numerous new settlements,

especially in the Alam Barajo and Kota Baru areas, where approximately 5,000 housing units were built during the COVID-19 pandemic. However, this number falls short of the target backlog of 30,000 housing units in Jambi city. Many of these unoccupied housing units hold the potential to become breeding grounds for Aedes sp. mosquitoes. The surge in dengue cases could be attributed to the expansion of residential areas. Aedes aegypti, being a domestic mosquito, thrives in close proximity to residential environments (Dom et al., 2013; Hastuti et al., 2017; Horta et al., 2014).

The Aedes sp breeds in water reservoirs, including puddles collected in containers. Presently, these mosquitoes have altered their breeding behavior, being capable of thriving in unclean or polluted water sources, like sewer water or water mixed with oil (Harahap & Tarigan, 2021; Ismainar et al., 2021). Poorly managed water reservoirs significantly contribute to the proliferation of Aedes sp mosquitoes due to the numerous potential breeding sites they offer. Increased breeding sites may result in a surge in larval populations, consequently bolstering the Aedes sp mosquito population. Failure to promptly and appropriately address these breeding grounds following the PSN (Healthy Clean and Tidy) concept could expedite dengue transmission (Rahayu & Siwiendrayanti, 2019).

Mosquitoes can inhabit various locations, extending beyond residential areas to public spaces, such as Tire Throwaway Sites (TTUs), especially during the rainy season when used tires accumulate water. TTUs serve as potential breeding sites for Aedes sp mosquito larvae, thus escalating the risk of dengue transmission (Swara & Triana, 2021).

From observations made between April and September 2023, it was noted that settlements in the Pinang Merah urban village area may heighten the transmission of dengue fever. This is due to the female Aedes sp mosquito's ability to fly an average of 40-100 meters, allowing them to travel and breed in other homes and residential areas within a radius of 100 meters.

Efforts to combat the issue of DHF have been initiated by the community, encompassing various measures like epidemiological investigations, fogging, the 3M plus movement, DHF awareness campaigns, and larvae monitoring executed by Jumantik Cadres and local Puskemas officers. Despite these efforts (Coreil et al., 2013; Lubis et al., 2021), the escalating DHF cases persist. The surge in DHF cases is attributed to the lack of community support for eradication endeavors. Evidently, the average Flick-Free Rate in 2022 remains higher than the national target. The Flick-Free Rate is an indicator reflecting community efforts in eliminating the Dengue Fever vector through Mosquito Nest Eradication activities (Irawan et al., 2017).

In a preliminary study conducted in January 2023 involving 2 Dengue Fever patients, no mosquito breeding sites were detected in the respondents' homes, but 60% of them possessed potential breeding areas outside the house, like gutters and discarded items.

This study endeavors to investigate the environmental conditions and behaviors contributing to the incidence of dengue fever within the working area of Pinang Merah Alam Barajo village, Jambi City.

MATERIALS & METHODS

This research follows an analytic observational approach with a cross-sectional design. The independent variables examined encompassed the presence of breeding sites within the house, outside the house, larvae presence in containers, Water Shelter (TPA) closure practices, landfill draining habits, used goods disposal or recycling practices, clothes hanging practices, larva card monitoring, larvae-eating fish keeping, and abate powder application in the landfill.

The study population comprised all individuals residing in the working area of

Pinang Merah Urban Village, Jambi City. Proportional random sampling was employed to select a substantial research sample consisting of 108 participants. Data were collected through interviews and observations. The questionnaire-based interview method was utilized to ascertain respondent characteristics and various independent variables related to the presence of breeding sites both inside and outside homes.

Statistical analysis in this study was conducted using the Chi-square test. The chi-square test necessitates cells with an expected value of less than 5, a maximum of 20% of the total number of cells, and no observed values of zero. If these conditions are unmet, the Fisher test is applied.

RESULT

The frequency distribution of research data, including respondent characteristics, research variables, and the correlation between variables, is presented in Table 1.

Table 1. Distribution of respondent characteristics

Characteristics	n	%
Age		
Adolescents 10-19 years	36	33.3
Adults 19-44 years	45	41.7
Pre-elderly 45-59 years	31	28.7
Gender		
Male	45	41.7
Female	63	58.3
Educational level		
Elementary	22	20.4
Junior school	40	37.6
High school	31	28.7
College	15	13.9
Occupation		
Farmer	19	17.6
Entrepreneur	36	33.3
Civil servants/Officer	12	11.1
Housewife	41	38

Table 1 shows that most respondents have an adult age of 19-44 years old at 41.7%, dominant female gender at 58.3%, junior school education level at 37.6%, working as a housewife at 38%.

Table 2. Frequency Distribution of Research Variables

Variables	Frequency	
	n	%
The habit of hanging up clothes		
Good	58	53.7
Poor	50	46.3
The habit of collecting rainwater around the house		
Good	100	92.6
Poor	8	7.4
Sowing abate powder in water reservoirs		
Good	75	69.4
Poor	33	30.6
Draining water reservoirs once a week		
Good	100	92.6
Poor	8	7.4
Burying and disposing of used goods in temporary garbage containers,		
Good	67	62
Poor	41	38
Conducting larva monitoring with larva cards		
Good	68	63
Poor	40	37
Raising larvae-eating fish		
Good	78	72.2
Poor	30	27.8

Table 2 indicates that 46.3% of respondents had a poor habit of hanging clothes, while only 7.4% demonstrated a poor practice of collecting rainwater around the house. However, 30.6% of respondents reported using abate powder in water reservoirs. The act of draining water reservoirs once a week was considered poor by 7.4% of respondents. Additionally, burying and disposing of used items in temporary garbage containers was rated poorly by 38% of respondents. Monitoring larvae with larvae cards was deemed inadequate by 37%, and keeping larvae-eating fish was considered insufficient by 27.8%.

Table 3. Relationship between behavioral variables and DHF incidence

Independent variable	DHF Incidence		p
	Exist	None	
	n (%)	n (%)	
The habit of hanging clothes			
Poor	22 (44%)	28 (56%)	**0.000**
Good	46 (79.3%)	12 (20.7%)	
The habit of collecting rainwater around the house			**0.004**
Poor	1 (12,5%)	7 (87.5%)	
Good	67 (67%)	33 (33%)	
Sowing abate powder in water reservoirs			0.380
Poor	22 (66.7%)	11 (33.3%)	
Good	46 (61.3%)	29 (38.7%)	
Draining water reservoirs			**0.004**
Poor	1 (12.5%)	7 (87.5%)	
Good	67 (67%)	33 (33%)	
Burying and disposing of used beaver			0.087
Poor	22 (53.7%)	19 (46.3%)	
Good	46 (68.7%)	21 (31.3%)	
Monitoring of larvae with cards			0.134
Poor	22 (55%)	18 (45%)	
Good	46 (67.6%)	22 (32.4%)	
Raising larvae-eating fish			0.122
Poor	22 (73.3%)	8 (26.7%)	
Good	46 (59%)	32 (41%)	

In Table 3, it is evident that out of the 7 respondent behaviors examined, three exhibited a significant relationship with the incidence of DHF: the habit of hanging clothes, the habit of collecting rainwater around the house, and draining water reservoirs (with a p-value < 0.05). However, the remaining 4 variables, namely sowing abate powder in water reservoirs, burying and disposing of used shells, monitoring larvae with cards, and keeping larvae-eating fish, showed no significant association.

DISCUSSION

Clothes Hanging Habits

The study revealed a notable association between the habit of hanging clothes and the incidence of DHF. This finding aligns with the research conducted by Handayani & Cholik (2019), which also established a significant correlation between hanging clothes and DHF incidence in OKI Regency. Aedes aegypti mosquitoes tend to prefer clothing items that have been worn and hung up as resting places, as these garments often contain human sweat with amino acids, lactic acid, and other substances that attract mosquitoes. Failure to control the hanging of clothes may lead to an increased mosquito population (Sutriyawan, 2021).

Families habitually hanging used clothes indoors, particularly in rooms and bathrooms, inadvertently create a favored environment for mosquitoes to rest, particularly during the hours when Aedes aegypti mosquitoes are most active in seeking blood meals – typically between 06:00-10:00 AM and 4:00-6:00 PM. This habit of hanging clothes has been linked to the presence of mosquitoes within households during specific times, which, if infected, may pose a potential risk of transmitting viruses to healthy individuals.

The habit of collecting rainwater around the house

There is a correlation between the habit of collecting rainwater around the house and the incidence of DHF. Respondents reported the discovery of larvae in containers around their homes during the research, indicating the presence of flying mosquitoes and larvae in water reservoirs. This suggests infrequent draining practices, allowing the efficient bionomic cycle of mosquitoes. This study aligns with previous research findings, which also highlighted a significant relationship between 3M plus behavior and the incidence of dengue hemorrhagic fever (DHF) (Periatama et al., 2022).

The presence of larvae significantly impacts their density. Containers harboring larvae

pose the potential to breed into adult mosquitoes. Containers with CI values reveal the percentage of containers with more than one adult mosquito, closely tied to the type, location, and quantity of containers within households. This research corroborates findings by Noviyani Dwi Raharjanti and Eram Stump Pawenang, with a reported p-value of 0.005, indicating a significant relationship between the number of containers and the presence of Aedes larvae (Triwahyuni et al., 2020).

The existence of larvae outside the house corresponds to breeding sites beyond the household premises, where the collection of rainwater serves as a prime breeding ground for larvae. Aedes sp mosquito eggs have the capability to survive for several months, leading to hatching even after extended periods (Santoso et al., 2018).

The Habit of Sowing Abate Powder

The findings of this study revealed no significant association between the practice of sowing abate powder and the incidence of DHF (p=0.669). This outcome aligns with prior research conducted by Khairun Nisa et al. (2022) and Siti Lailatin Nasifah & Mahendrasari Sukendra (2021), indicating a lack of significant relationship between abate application and the incidence of DHF.

Abate, a larvicide, is used to eliminate insect larvae in their early stages before reaching adulthood in water bodies (Da et al., 2020). The recommended dose for abate powder application is approximately one tablespoon or 10 grams per 100 liters of water. It should be replaced every 2-3 months since the effectiveness of abate powder in eradicating mosquitoes lasts for that duration only. The absence of a correlation with abate powder sowing could be attributed to the non-standardized application. In practice, 1 gram of abate powder packet is usually utilized for 200 liters of water in a drum and often remains in place for over 3 months, leading to a decline in its efficacy.

Using abate or temefos larvicides inadequately can induce resistance. A significant factor contributing to the resistance of Aedes sp., particularly Aedes aegypti and Aedes albopictus, the primary vectors of dengue transmission, against organophosphates like temefos, is associated with metabolic factors resulting in the formation of detoxification enzymes, especially esterases. Additionally, factors such as cuticle thickening and residual changes due to mutations also contribute to this resistance.

Draining water reservoirs once a week

The study revealed a significant relationship between draining water reservoirs once a week and the incidence of DHF (p=0.004). Regularly draining water reservoirs is an effective measure to hinder the breeding of DHF vectors. This finding corresponds to research conducted by Habibie et al. (2023), which highlighted that draining water reservoirs is an effective strategy in diminishing larval population growth. It involves practices such as draining bathtubs, buckets, and other receptacles regularly, securely sealing containers like buckets, pots, and bathtubs, and burying disused items that can trap water and harbor larvae, such as cans, bottles, and tires. Reducing the breeding grounds for larvae, particularly in items like bottles, used goods, and tires, adheres to the principles of 3R (Reduce, Reuse, and Recovery).

Implementing 3M Plus efforts at an individual and household level includes draining water containers at least once a week and using abate powder when larvae are detected around containers or water reservoirs. Moreover, to mitigate mosquito larvae density, 3M Plus practices is recommended not only in dengue-endemic areas but also in non-dengue-endemic regions to effectively manage larval density and presence.

Burying and disposing of used goods in temporary garbage containers

The study's findings revealed no significant association between the practice of burying/recycling used goods and the incidence of DHF (p=0.87). This outcome aligns with previous research conducted by Tamza & Suhartono (2013), which also reported a p-value of 0.616, indicating the absence of a correlation between the habit of burying used goods and the occurrence of DHF. Burying used goods refers to the practice of burying discarded items like used bottles, cans, and other materials that have the potential to collect rainwater (Rosdawati, 2021).

Observations in the study area indicated that residents dispose of waste, including used goods, into trash containers, which are subsequently collected by sanitation workers every three days.

Conducting larva monitoring with larva cards

The findings of this study reveal no correlation between monitoring larvae with larval cards and the incidence of DHF (p = 1.34). This result contrasts with the research conducted by Swara & Triana (2021), which highlighted those certain respondents emphasized the importance of larval monitoring cards in controlling larvae as a vital tool within the Gerakan Satu Rumah Satu Jumantik (G1R1J) program. As per the G1R1J Implementation Technical Guidelines, the larva card serves as a reporting medium for community-based surveillance activities. The flick card is regularly filled out once a week by house Jumantiks (GIRIJ) in this particular study area (Maksum & Syaputra, 2023).

Raising larvae-eating fish

The study's findings reveal no association between keeping larvae-eating fish and the incidence of DHF (p=0.122). This aligns with prior research conducted by Nasifah & Sukendra (2021), which also concluded that there's no link between keeping larvae-eating fish and the occurrence of DHF. Observation in the environment indicates that respondents who keep larvae-eating fish mainly use them as ornamental fish rather than as a method to prevent dengue disease. This differs from other research suggesting that larvae-eating fish should be placed in hard-to-drain or large water reservoirs as a preventive measure against dengue (Harsono, 2019). The absence of an association between keeping larvae-eating fish and DHF incidence in this study might be influenced by other factors, such as the study being conducted during the rainy season. During this time, the Aedes sp mosquito population tends to increase due to the hatching of dormant eggs in breeding habitats like non-daily used water reservoirs and natural landfills that start to collect water. Such conditions can escalate mosquito populations, potentially intensifying the transmission of the dengue virus (Della Pangesti, 2021).

CONCLUSION

The conclusion drawn from this study indicates that Aedes sp breeds in stagnant water accumulated in containers. Hanging used clothes serves as a favored resting place for these mosquitoes. Furthermore, there was no observed association between the habit of burying or recycling used goods and the incidence of DHF. Routine monitoring, installation of larva cards, and lack of cleaning were also found to have no direct correlation with DHF incidence.

Declaration by Authors

Ethical Approval:

This study obtained ethical feasibility under the Health Research Ethics Commission of the Ministry of Health, Jambi, and registration number: LB.02.06/2/94/2022

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